

A New Moray Eel (*Gymnothorax*: Muraenidae) from Japan and Hawaii

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Abstract A new muraenid, *Gymnothorax ypsilon*, is described from seven specimens from Japan and four from the Hawaiian Islands. It has about 30 narrow dark bars on the body, some of which are Y-shaped on most specimens, a uniformly colored head, an anal fin with a white margin, and 141–153 vertebrae. It differs from *G. pikei*, its most similar species, by a white margin of the anal fin.

In 1968 Dr. Thomas A. Clarke of the University of Hawaii collected four specimens of a moray with a fish trap set in 183 m off Barbers Point, Oahu, Hawaiian Islands. He preserved the specimens in spiral shape in a 4-gallon glass bucket of very strong formalin. Unable to identify the specimens beyond the genus *Gymnothorax*, he showed them to the junior author who determined that they seemed to represent an undescribed species. Clarke (1972) reported them as *Gymnothorax* sp. and presented them to the Bishop Museum, Honolulu. Their present spiral shape precluded photography and the taking of measurements or radiographs. The junior author therefore decided to wait for additional specimens to be collected before describing the species. However, no further specimens of this moray have been collected in Hawaiian waters.

During his investigation of Japanese muraenid fishes, the senior author found specimens of the same species, also from relatively deep water. Some of these specimens have been reported in the literature under erroneous names. Kamohara (1940a) misidentified the species as *Gymnothorax richardsoni* (Bleeker); Chen and Weng (1967) and Hatooka and Yoshino (1982) called it *Gymnothorax punctatofasciatus* Bleeker. With more specimens and more careful study, the senior author determined this moray to be a new species, though reporting it as *Gymnothorax* sp. in "Fishes of the Japanese Archipelago" (Hatooka, 1984). With the publication of this voluminous work, the junior author became aware of the existence of the species in Japan. We have therefore joined forces in writing its description.

The methods of measurements follow those of Hatooka and Yoshino (1982). The count methods of predorsal and preanal vertebrae follow those of

Böhlke (1982). The vertebral counts of the holotype of *Gymnothorax pikei* and one specimen of *G. punctatofasciatus* are from Böhlke (1982). Proportional measurements of type specimens of the new species are expressed as percentages of the total length (TL) or the head length (HL). Proportions and vertebral counts are given in Table 1.

The type specimens are deposited in the Bernice P. Bishop Museum, Honolulu (BPBM); the Department of Fisheries, Faculty of Agriculture, Kyoto University (FAKU); the Seto Marine Biological Laboratory of Kyoto University, Shirahama (SMBL-F); the Department of Marine Sciences of the University of the Ryukyus, Uehara (URM-P); and the Department of Zoology, University Museum, University of Tokyo (ZUMT).

Gymnothorax ypsilon sp. nov.

(Japanese name: Okinoshima-utsubo)

(English name: Y-bar moray)

(Figs. 1, 2; Tables 1–3)

Gymnothorax richardsoni (not of Bleeker): Kamohara, 1940a: 435, fig. 2 (Okinoshima Island, Kochi Prefecture); Kamohara, 1940b: 12 (in key); Kamohara, 1941: 503 (Okinoshima Island, Kochi Prefecture); Matsubara, 1955: 353 (in key); Kamohara, 1958: 17 (listed, in part); Kamohara, 1964: 21 (listed, in part).

Gymnothorax punctatofasciatus (not of Bleeker): Chen and Weng, 1967: 24, fig. 15 (Keelung, Taiwan); Hatooka and Yoshino, 1982: 88, pl. I, fig. 3 (near Uotsurijima Island, Senkaku Islands).

Gymnothorax sp.: Clarke, 1972: 312, 315 (Barbers Point, Oahu); Oka, 1973: pl. 26 (Glover's Picture Book, Vol. 1, Group 4); Hatooka, 1984: 24, pl. 28-D (Japan); Shirai, 1986: 59 (Japan); Clark, 1990: 19 (Suruga Bay, in photographs).

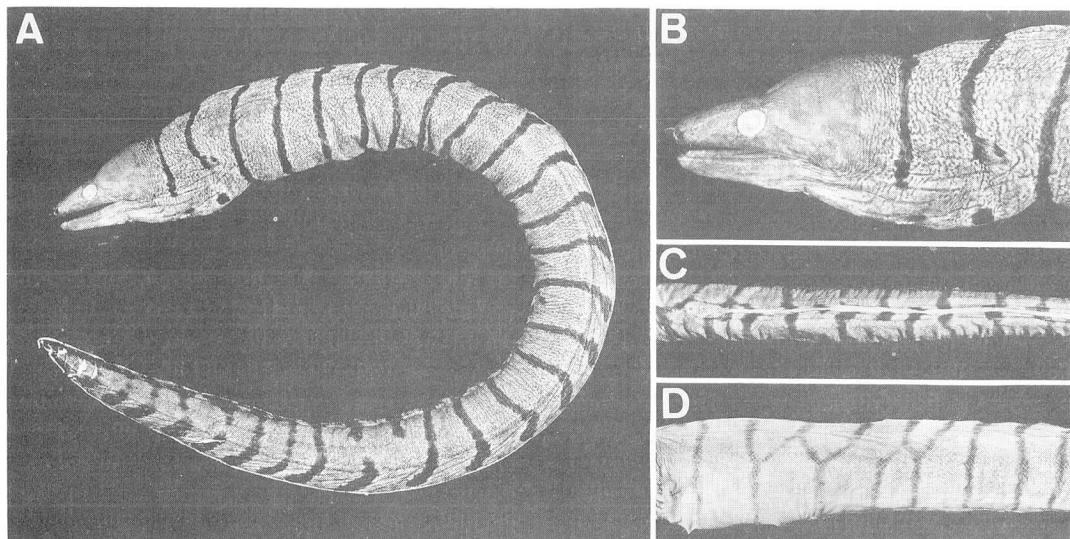


Fig. 1. *Gymnothorax ypsilon* sp. nov. A, holotype, URM-P 1783, 724 mm TL, near Uotsurijima Island, Senkaku Islands; B, head of holotype; C, ventral view of tail of holotype; D, Y-shaped bars on trunk of paratype, FAKU 100530, 644 mm TL, Kochi Prefecture.

Holotype. URM-P 1783, 724 mm TL, near Uotsurijima Island, Senkaku Islands, T. Yoshino, July 1981.

Paratypes. FAKU 51430, dissected, 486 mm TL, near Senkaku Islands ($26^{\circ}24'N$, $125^{\circ}20'E$), longline, T. Yoshino, 19 July 1982; FAKU 51604, 624 mm TL, off northern shore of Iejima Island, Ryukyu Islands, fish trap, M. Toda, 22 Dec. 1981; FAKU 100530, 644 mm TL, Kochi, M. Katayama, 10 Mar. 1953; SMLB-F 73341, 571 mm TL, Naha fish market, Okinawa, T. Yoshino, June 1973; ZUMT 55591 and 55594, 675 mm and 624 mm TL, off Niijima Island, Izu Islands ($34^{\circ}26.8'N$, $139^{\circ}10.8'E$ – $34^{\circ}26.5'N$, $139^{\circ}10.0'E$), longline at depths of 120–146 m, H. Senou, 30 Sept. 1986; BPBM 9643 (4 specimens), 735–890 mm TL, off Barbers Point, Waianae coast, Oahu, Hawaiian Islands, overnight fish trap at 100 fathoms (183 m), T. A. Clarke, 14–15 Dec. 1968.

Comparative materials. *Gymnothorax berndti*: FAKU 101657, dissected, 538 mm TL, Naha, Okinawa, 31 July 1967; NRIFSF (National Research Institute of Far Seas Fisheries)-EE 254 and 266, 612–655 mm TL, Capel Bank ($25^{\circ}21.2'S$, $159^{\circ}46.6'E$), 16 Dec. 1976, R/V "Kaiyo-maru," 1976 cruise, bottom longline at depths of 213–265 m; NRIFSF-EE 516 and 879 (3 specimens), 528–687 mm TL, Tonga Ridge ($23^{\circ}24.8'S$, $176^{\circ}13.3'W$), 14 Jan. 1977, R/V "Kaiyo-maru," 1976 cruise, bottom long line at depths of 160–171 m; URM-P 588, 659 mm TL, Okinawa, 18 Dec. 1973; URM-P 1432, 609 mm TL, Okinawa, 1960; URM-P 1782, 805 mm TL, near Uotsurijima Island, Senkaku Islands, T. Yoshino, July 1981.

Diagnosis. A species of *Gymnothorax* of moder-

ate length (largest 890 mm). Dorsal fin moderately high, its origin before gill opening. Anus before mid-body. Jaw teeth sharp and uniserial. Body creamy light brown with 26–35 distinct, narrow, dark crossbars extending onto fins (some bars on most specimens Y-shaped). Anterior part of head uniformly light brown. Anal fin with a white margin.

Description (data for holotype followed in parentheses by the mean and range of data for the holotype and paratypes). Anus in front of mid-body, the preanal length 2.27 (2.27; 2.18–2.35); head length 7.77 (7.93; 7.29–8.29); body elongate and compressed (Fig. 1A), the depth at anus 19.1 (19.5; 16.5–26.0) and at gill opening 16.1 (16.2; 13.6–22.2), all in TL. Eye diameter 12.6 (11.7; 10.4–15.6); interorbital width 9.32 (9.35; 7.95–11.0); snout pointed, the length 4.57 (4.79; 4.56–5.10); mouth cleft length 2.10 (2.18; 1.95–2.46); predorsal length 1.20 (1.23; 1.15–1.33), all in HL. Dorsal fin height at anus 2.51 (2.15; 1.83–2.51) in body depth at anus. Predorsal vertebrae 5 (5.5; 5–7), preanal vertebrae 56 (56.5; 55–60), abdominal vertebrae 65 (64.8; 62–68), caudal vertebrae 84 (84; 79–87), total vertebrae 149 (148.9; 141–153).

Dorsal fin moderately high, its origin before gill opening and arising above 5–7th vertebra. Anal fin low, its origin just behind anus and below 55–60th vertebra. Gill opening nearly horizontal, its center

Table 1. Proportions and vertebral counts of the holotype and 10 paratypes of *Gymnothorax ypsilon* sp. nov.

	Holotype				Paratypes					
	URM-P 1783 male	FAKU 51430 female	FAKU 51604 female	SMBL-F 100530 male	ZUMT 55591 male	BPM 9643-1 male	BPM 9643-2 female	BPM 9643-3 female	BPM 9643-4 male	
Total length (mm)	724	486	624	644	571	675	624	772	735*	776
% of Total length										890
Preanus length	44.1	44.4	42.6	43.2	42.9	45.8	45.0	43.7	44.2	45.5
Head length	12.9	12.4	12.5	12.1	12.1	13.7	13.2	13.0	12.1	12.1
Body depth (anus)	5.2	3.8	4.8	4.1	6.1	5.8	5.6	5.3	5.3	5.5
Body depth (gill op.)	6.2		5.4	4.5	5.4	7.1	7.3	7.1	7.3	6.6
% of Head length										
Predorsal length	83.0	82.1	75.0	79.3	78.8	78.8	77.0	84.3	86.8	85.7
Mouth cleft length	47.5	43.2	40.7	41.6	46.4	46.4	43.0	46.6	48.0	50.1
Snout length	21.9	21.2	20.2	21.4	21.3	21.1	19.6	19.6	21.9	21.6
Eye diameter	7.9	9.4	9.0	6.4	8.5	9.0	7.9	8.2	9.1	8.9
Interorbital width	10.7	9.1	10.6	10.8	10.4	11.3	10.2	11.2	10.5	10.2
% of Body depth										
Dorsal fin height	39.8	40.6	41.9	52.7	51.7	47.2	43.7	46.5	54.7	45.7
Predorsal vertebrae	5	5	7	5	5	6	5	6	5	6
Prenal vertebrae	56	60	55	59	57	56	55	56	55	55
Abdominal vertebrae	65	68	65	66	64	66	63	64	62	64
Caudal vertebrae	84	85	86	87	86	87	79	79	79	80
Total vertebrae	149	153	151	153	152	151	153	142	141	144

* tip of tail missing.

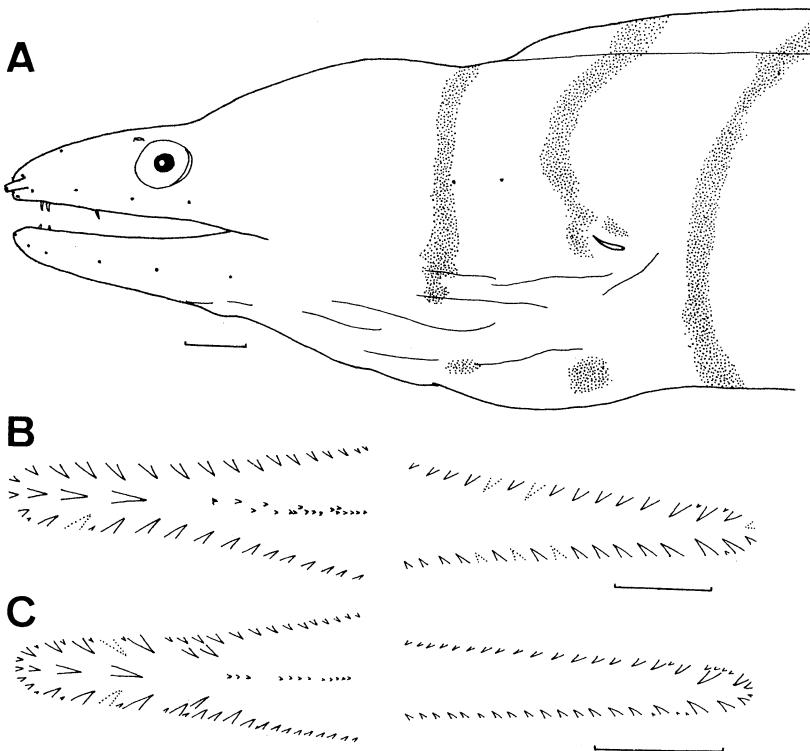


Fig. 2. *Gymnothorax ypsilon* sp. nov. A, head of holotype, URM-P 1783, 724 mm TL; B, dentition of male, holotype; C, dentition of female, paratype, FAKU 51604, 624 mm TL. Each scale indicates 10 mm.

slightly below mid-body, and its length somewhat less than eye diameter.

Anterior nostril a slender tube on each side of tip of snout, extending beyond edge of upper lip when depressed. Posterior nostril over front edge of eye, with a slightly raised rim.

Head pores very small but distinct (Fig. 2A). Supraorbital canal with three pores, one of which is situated anteroventrally to anterior nostril. Infraorbital canal with four pores. Mandibular canal with six pores (one paratype with 5 pores and another with 7 pores in this canal). Two pores situated anterodorsally to gill opening.

Upper jaw slightly longer than lower, the mouth closing completely. Teeth in jaws uniserial, stout, pointed and slightly retrorse (Fig. 2B). Teeth of peripheral series of premaxillary plate 12 (12 in male paratypes and 12–14 in females; these counts include shed teeth); lateral teeth somewhat larger than anterior ones. Very small teeth visible in some spaces between lateral teeth of peripheral series of premaxillary plate. Mesial part of premaxillary plate with three teeth, the posterior larger (seven para-

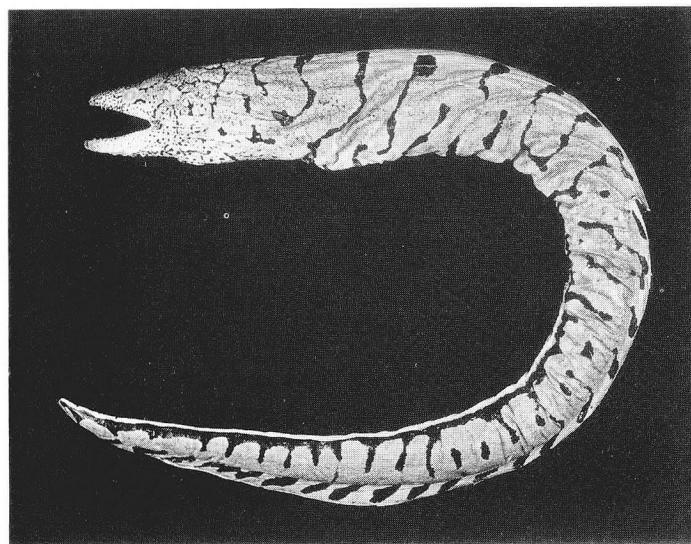
types with three teeth, two paratypes with two, and one with a single tooth). Prevomerine teeth minute and 6–18 in number, those of holotype and one paratype in an irregular single row, and those of other paratypes in a straight row. Maxillary teeth in a single row, 11 on left and 10 on right side of jaw of holotype. Maxillary tooth counts somewhat different in each sex, 9–13 in males (include holotype) and 12–16 in females. Moreover, smaller females have additional inner teeth anteriorly in maxilla (Fig. 2C); teeth of this row slightly more slender and longer than those of outer row and 1–4 in number. Teeth of mandible in a single row, 16 on left and 17 on right side of jaw of holotype. Mandibular tooth counts also somewhat different in each sex, 16–18 in males (include holotype) and 18–20 in females. Anteriormost mandibular teeth rather small, the second or third tooth largest. As in the peripheral row of premaxillary teeth, very small teeth visible in some spaces between larger teeth near symphysis.

Color in formalin or isopropanol light brown, overlain with 30 (26–35) distinct, straight, narrow dark brown bars which extend onto median fins (Fig.

Table 2. Teeth counts of the holotype and 10 paratypes of *Gymnothorax ypsilon* sp. nov.

	Male				Female				
	SMBL-F 73341	ZUMT 55594	ZUMT 55591	URM-P 1783	BPBM 9643-1	FAKU 51430	FAKU 51604	BPBM 9643-2	BPBM 9643-3
Total length (mm)	571	624	675	724	772	890	486	624	735* ¹
Teeth counts* ²									776
Premaxillary									
peripheral series	12	12	12	12	12	13	13	14	12
medial series	3	3	3	3	2	3	3	3	12
Maxillary (left, right)									
outer series	10, 11	12, 13	9, 10	11, 10	10, 11	11, 11	16, 16	14, 14	14, 13
inner series	0, 0	0, 0	0, 0	0, 0	0, 0	0, 0	2, 4	2, 1	1, 3
Mandible (left, right)	16, 15	18, 18	18, 17	16, 17	17, 18	18, 18	18, 18	20, 19	19, 19

¹* Tip of tail missing.²* Including shed tooth.

Fig. 3. *Gymnothorax berndti*, URM-P 588, 659 mm TL, Okinawa.

1A), 2 (2–3) bars before gill opening (but none anterior to corner of mouth), 10 (7–13) on trunk, and 18 (16–21) on tail. Most specimens with some

bars branching dorsally, thus forming Y-shaped markings. Width of bars nearly equal to or narrower than eye diameter. Interspaces between bars in

Table 3. Comparisons of proportions and vertebral counts of *Gymnothorax ypsilon* sp. nov. and *G. pikei*. The number of specimens examined are given in parentheses

	<i>ypsilone</i> sp. nov.		<i>pikei</i> * ¹	
	Japan (7)	Hawaii (4)* ²	Holotype	Papua New Guinea
Total length (mm)	486–724	735–890	905	807
% of total length				
Preanus length	42.6–45.8	43.7–45.5* ³		47.5
Head length	12.1–13.7	12.1–13.0* ³	13.5	15.1
Body depth (anus)	3.8– 6.1	5.3– 5.6* ³		
Body depth (gill op.)	4.5– 7.3	6.6– 7.3	7.5* ⁴	6.9* ⁴
% of Head length				
Predorsal length	75.0–83.0	77.0–86.8		72.2
Mouth cleft length	40.7–47.5	46.6–51.3	45.5	39.7
Snout length	19.6–21.9	19.6–21.9	22.2	19.2
Eye diameter	6.4– 9.4	8.2– 9.6	6.6	8.6
Interorbital width	9.1–11.3	10.2–12.6		10.6
Predorsal vertebrae	5–7	5–6	5* ⁵	
Preanal vertebrae	55–60	55–56	58* ⁵	54
Abdominal vertebrae	64–68	62–64		
Caudal vertebrae	84–87	79–80* ³		
Total vertebrae	149–153	141–144* ³	148* ⁵	145

*¹ Recalculated values on the basis of Kailola (1975).

*² One of four specimens missing tip of tail.

*³ Data of tail tip missing specimens excluded.

*⁴ Body depth behind gill opening.

*⁵ Data from Böhlke (1982).

body very finely mottled or meshed with dark brown. Left and right bars in trunk not connecting on belly. Some specimens with an interrupted dark stripe along midventral line. Anterior part of head plain brown (Fig. 1B). Anal fin with a distinct white margin (Fig. 1C), and dorsal fin also with a white margin posteriorly (these white margins somewhat obscure in larger specimens). Inside of mouth light brown. Color in life as in preservative.

Distribution. Southern Japan to Taiwan, and the Hawaiian Islands.

Remarks. *Gymnothorax ypsilon* is closely related to *G. pikei* Bliss (1883), *G. berndti* Snyder (1904), and *G. punctatofasciatus* Bleeker (1863); all have a color pattern of narrow dark bars. *G. pikei* is known only from single specimens from Mauritius and Papua New Guinea. *G. berndti* (Fig. 3), known from the Hawaiian Islands and the western Pacific, occurs in rather deep water for a moray. *G. punctatofasciatus* was originally described from Ambon, Indonesia, though its range has been extended to the Philippines and India (records from Zanzibar and Réunion are doubted by Smith, 1962).

G. ypsilon is distinguished from *G. berndti* and *G. punctatofasciatus* in having more vertebrae (141–153, compared to 135–139 in *berndti* and 137 [after Böhlke, 1982] in *punctatofasciatus*) and its plain-colored head. *G. berndti* and *G. punctatofasciatus* have the same coloration on the head as in the spaces between the dark bars of the body (fine dark brown meshwork in *berndti* and dark blotches in *punctatofasciatus*). In addition, in *G. berndti*, the adjacent bars of the tail are continuous with each other on the basal part of the anal fin (Fig. 3), while in *G. ypsilon* the bars are not connected (Fig. 1A, C). Moreover, the lower jaw of *G. berndti* tends to project anterior to the upper (in *G. ypsilon*, the upper is projecting).

Of the above-mentioned three related species, *G. pikei* is most similar to the present species. It was described by Bliss (1883) from a single specimen from Mauritius. A second specimen was collected from Papua New Guinea and described in detail by Kailola (1975). *G. pikei* is similar in general coloration, proportions (Table 3), dentition, and vertebral counts to *G. ypsilon*. *G. ypsilon* differs from *G. pikei* in having the anal and caudal fin with a distinct white margin and in the barred pattern. In *G. pikei*, the anal fin lacks a white margin, and the bars of body continue across the fins; near the tail tip the fins are dark-bordered (after Kailola, 1975). In addition, some less obvious differences were noted: 1) dark

bars of *G. ypsilon* are narrower than those of *G. pikei* (width of bars nearly equal to or narrower than eye diameter vs. wider in *G. pikei*) and rather straight in shape (bars more irregular in *G. pikei*), 2) head length of *G. ypsilon* shorter (12.1–13.7% of TL vs. 13.5–15.1), 3) preanus length of *G. ypsilon* shorter (42.6–45.8 vs. 47.5).

Hatooka (1986) demonstrated sexual dimorphism in the number of jaw teeth of *Gymnothorax richardsoni*, the female having more teeth than the male on the premaxillary plate, maxilla, and mandible and an additional inner tooth row on the maxilla. The female of *G. ypsilon* also has more maxillary and mandibular teeth than the male, and an additional inner maxillary tooth row except larger females (Table 2). These differences were observed in only the few available specimens and are a little obscure, but they agree with sexual differences in the maxillary and mandibular teeth of *G. richardsoni*, suggesting that *G. ypsilon* also exhibits sexual dimorphism in jaw teeth.

Collection data indicate that *G. ypsilon* lives in rather deep water (more than 100 m) for a muraenid eel.

We were surprised to find that there is a significant difference in the number of vertebrae between specimens from Japan and Hawaii (Table 3). Because of the great similarity in all other characters, we nevertheless regard the specimens from the two areas as conspecific.

Etymology. The species is named *ypsi* after the 20th letter of the Greek alphabet, in reference to the Y-shaped dark bars often found on this moray; it is a noun in apposition.

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南日本およびハワイより得られたウツボ属魚類の1新種 オキノシマウツボ

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南日本およびハワイより得られた標本に基づき、ウツボ属の1新種 *Gymnothorax ypsilon* を記載した。本種は、日本では従来より高知および沖縄近海から知られ、オキノシマウツボという和名が与えられていたが、未記載種であった。本種は、体に約30のやや細い黒褐色横帯を持ち、その横帯のいくつかは多くの個体でY字状になること、頭部は単色で斑紋がないこと、臀鰭が白く縁取られること、脊椎骨数は141–153であること等を特徴とする。また、ウツボ科魚類としてはやや深所に生息する。本種は、全体的な斑紋、体部比、歯等において、モーリシャス、パプア・ニューギニアより知られている *G. pikei* に酷似するが、後者では臀鰭に白色縁がなく、横帯は垂直鰭の末端にまで達すること、また、尾端部付近の垂直鰭はむしろ黒く縁取られること等により区別できる。

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